



Precious Metal Catalysts

for the Fine Chemical, Pharmaceutical
and Agrochemical Industry

Process Optimization with Precious Metal Catalysis

Catalysts are a particularly crucial component in the production processes of the fine chemical, pharmaceutical and agrochemical industries. Complex molecules require complicated, multi-step synthesis routes that often result in low yields and a larger amount of by-products. For companies in these industries, optimizing these synthesis pathways is critical as it can improve cost efficiency, increase yield, and reduce waste. This challenge requires innovative approaches and advanced technologies to improve production methods.

Heraeus Precious Metals offers a comprehensive range of homogeneous and heterogeneous precious metal catalysts that are characterized by high activity, selectivity and recyclability. This makes them the perfect tool for carrying out complex syntheses, e.g. for the production of active ingredients under low pressure and at low temperature, which nevertheless enable high yields. By recovering the precious metals from end-of-life catalysts via recycling, the financial value can be regained and the secondary precious metals reused in the production of new catalysts.

HOMOGENEOUS CATALYSTS

- › Extensive portfolio of salts and compounds for all precious metals
- › Focus on palladium phosphines for C-C coupling reactions
- › High quality catalysts, e.g. for asymmetric hydrogenation, hydroformylation, hydrosilylation
- › Tailor-made solutions for customer processes



HETEROGENEOUS CATALYSTS

- › High quality catalysts, e.g. for hydrogenation and oxidation reactions
- › Customized and value engineered catalyst solutions to your application needs
- › Perfect combination of activity, selectivity and recyclability for high performance
- › High expertise in custom and toll manufacturing solutions



A Unique One-Stop-Shop: Precious Metals Services

PRECIOUS METALS TRADING

Through trading centers in Hanau (Germany), New York City and Shanghai, Heraeus Precious Metals is able to execute precious metal trades under current market conditions. In addition to sales and purchasing transactions, it can provide financing options to its customers based on precious metal leasing.

PRECIOUS METALS INNOVATION

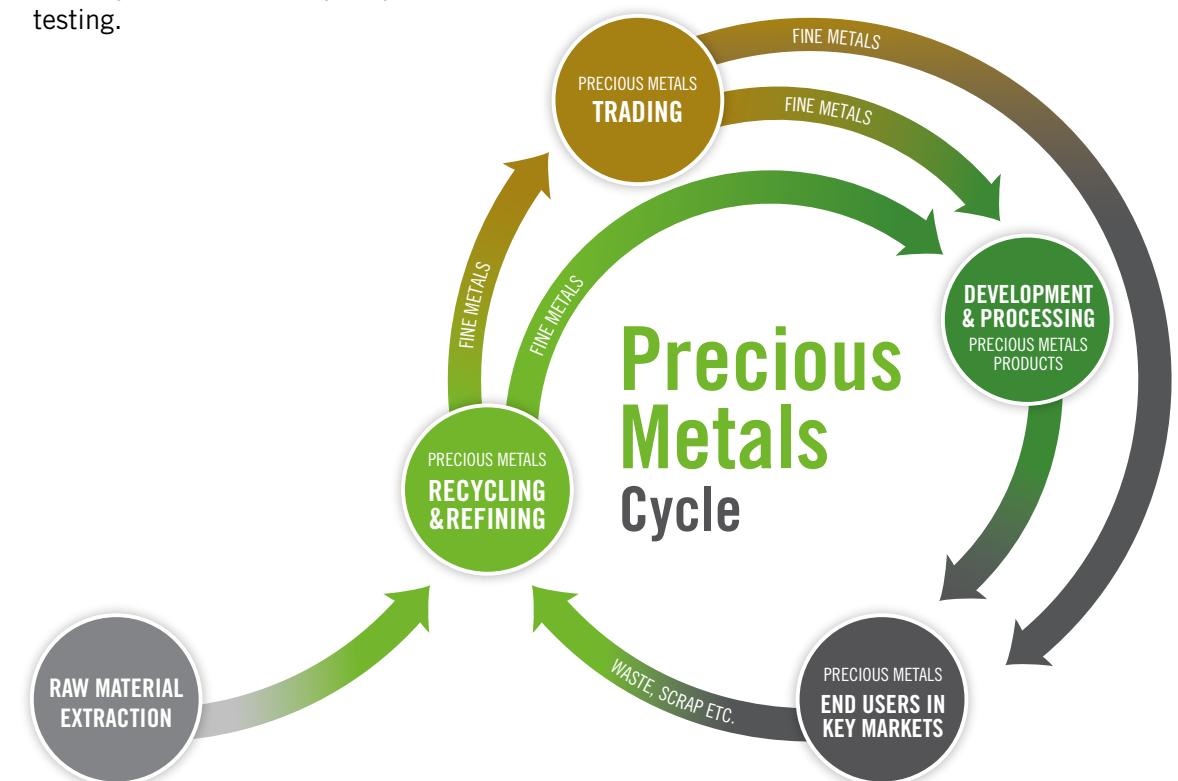
Heraeus Precious Metals operates Global Innovation Centers in Germany, China and the USA. The team of researchers and developers work on developing new products, advising customers and collaborating with them on synthesis solutions.

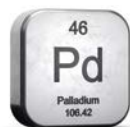
PRECIOUS METALS RECYCLING

As a specialist in the handling of spent precious metal catalysts, Heraeus uses state-of-the-art technologies to pretreat, sample, and refine valuable materials and ensure high return rates. The reclaimed precious metal can be used again for the manufacture of new catalysts, reducing the demand for primary precious metals.

PRECIOUS METALS ANALYTICS

The Global Competence Center Analytics combines state-of-the-art equipment for a wide range of analytical methods with a highly qualified team of precious metal scientists. Services include expert advice to customers to provide them with optimum support in product quality, development projects and the determination of precious metal content and purity in order to meet industry standards for quality and material testing.



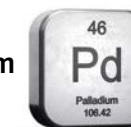
**Pd(0) Compounds**

Product Name	CAS No.	Formula	Avg. PM Content	Mol. Weight
Pd₂(dba)₃	51364-51-3	C ₆₈ H ₅₆ O ₄ Pd ₂	20.0%	1150.03
Pd(dba)₂	32005-36-0	C ₃₄ H ₂₈ O ₂ Pd	20.0%	575.02
Pd₂dba₃ x CHCl₃	52522-40-4	C ₅₂ H ₄₃ Cl ₃ O ₃ Pd ₂	20.6%	1035.10
Pd(PPh₃P)₄	14221-01-3	C ₇₂ H ₆₀ P ₄ Pd	9.2%	1155.59

Pd(II) Compounds

Product Name	CAS No.	Formula	Avg. PM Content	Mol. Weight
PdCl₂	7647-10-1	PdCl ₂	60.0%	177.31
Pd(II) acetate	3375-31-3	C ₄ H ₁₂ O ₄ Pd	48.0%	224.51
Pd(II) acetate „N-free“	3375-31-3	C ₁₂ H ₃₆ O ₁₂ Pd ₃	47.4%	224.51
Pd(acac)₂	14024-61-4	C ₁₀ H ₁₄ O ₄ Pd	34.9%	304.64
[Pd(allyl)Cl]₂	12012-95-2	C ₆ H ₁₀ Cl ₂ Pd ₂	58.2%	365.89
Pd(COD)Cl₂	12107-56-1	C ₈ H ₁₂ Cl ₂ Pd	37.3%	285.50
Pd(MeCN)₂Cl₂	14592-86-4	C ₄ H ₆ Cl ₂ N ₂ Pd	41.0%	259.43
Pd(PhCN)₂Cl₂	14220-64-5	C ₁₄ H ₁₀ Cl ₂ N ₂ Pd	27.7%	383.57
[Pd(cinnamyl)Cl]₂	12131-44-1	C ₁₈ H ₁₈ Cl ₂ Pd ₂	41.0%	518.08

As key players in organic synthesis, palladium catalysts offer a wide array of chemical transformations. Popular options include catalysts like Pd(PPh₃)₄ and Pd(OAc)₂ for cross-coupling and C-H activation respectively. Other significant catalysts such as PdCl₂(PPh₃)₂ and Pd(dba)₂ pave the way for Stille and Sonogashira reactions. Further palladium compounds and information are available on request. Our technical experts will be pleased to advise you on your inquiries.

**Pd(II) Phosphine Complexes: Monodentate Ligands**

Product Name	CAS No.	Formula	Avg. PM Content	Mol. Weight
Pd(PPh₃)₂Cl₂	13965-03-2	C ₃₆ H ₃₀ Cl ₂ P ₂ Pd	15.0%	701.90
Pd(P(o-tol))₃)₂Cl₂	40691-33-6	C ₄₂ H ₄₂ Cl ₂ P ₂ Pd	13.5%	786.06
Pd(Amphos)₂Cl₂	887919-35-9	C ₃₂ H ₅₆ Cl ₂ N ₂ P ₂ Pd	15.0%	708.08
Pd(PtBu₂Ph)₂Cl₂	34409-44-4	C ₂₈ H ₄₆ Cl ₂ P ₂ Pd	17.1%	621.94
Pd(PCy₃)₂Cl₂	29934-17-6	C ₃₆ H ₆₆ Cl ₂ P ₂ Pd	14.4%	738.19

Pd(II) Phosphine Complexes: Bidentate Ligands

Product Name	CAS No.	Formula	Avg. PM Content	Mol. Weight
Pd(dppe)Cl₂	19978-61-1	C ₂₆ H ₂₄ Cl ₂ P ₂ Pd	18.5%	575.74
Pd(dppp)Cl₂	59831-02-6	C ₂₇ H ₂₆ Cl ₂ P ₂ Pd	18.0%	589.77
Pd(dppb)Cl₂	29964-62-3	C ₂₈ H ₂₈ Cl ₂ P ₂ Pd	17.6%	603.79
Pd(dppf)Cl₂	72287-26-4	C ₃₄ H ₂₈ Cl ₂ FeP ₂ Pd	14.5%	731.70
Pd(dppf)Cl₂ x CH₂Cl₂	95464-05-4	C ₃₅ H ₃₀ Cl ₄ FeP ₂ Pd	13.0%	816.64
Pd(dtbpf)Cl₂	95408-45-0	C ₂₆ H ₄₄ Cl ₂ FeP ₂ Pd	16.3%	651.74
Pd(DPEPhos)Cl₂	205319-06-8	C ₃₆ H ₂₈ Cl ₂ OP ₂ Pd	14.9%	715.88
Pd(Xantphos)Cl₂	205319-10-4	C ₃₉ H ₃₂ Cl ₂ OP ₂ Pd	14.1%	755.95

Further phosphine complexes and information are available on request. Our technical experts will be pleased to advise you on your inquiries.





Pt(II) Compounds

Product Name	CAS No.	Formula	Avg. PM Content	Mol. Weight
Pt(acac) ₂	15170-57-7	C ₅ H ₇ O ₂ Pt	49.6%	393.29
Pt(PPh ₃) ₂ Cl ₂	15604-36-1	C ₃₆ H ₃₀ Cl ₂ P ₂ Pt	24.7%	790.57
[Pt(cyclohexene)Cl ₂] ₂	12176-53-3	C ₁₂ H ₂₀ Cl ₄ Pt ₂	56.0%	696.26
Pt(COD)Cl ₂	12080-32-9	C ₈ H ₁₂ Cl ₂ Pt	52.1%	374.16
Pt(nbd)Cl ₂	12152-26-0	C ₇ H ₈ Cl ₂ Pt	54.5%	358.12
Pt(MeCN) ₂ Cl ₂	13869-38-0	C ₄ H ₆ Cl ₂ N ₂ Pt	56.0%	348.09
Pt(BnCN) ₂ Cl ₂	15617-19-3	C ₁₄ H ₁₀ Cl ₂ N ₂ Pt	41.3%	472.23

Further platinum compounds and information are available on request. Our technical experts will be pleased to advise you on your inquiries.

Hydrosilylation Catalysts

Product Name	CAS No.	Formula	Avg. PM Content	Mol. Weight
Karstedt's catalyst	68478-92-2	O[Si(CH ₃) ₂ CH=CH ₂] ₂ Pt	19.7%	–
Ashby's catalyst	68585-32-0	C ₁₂ H ₂₄ O ₄ SiPt	17.0%	–
Pt(dodecene)Cl ₂	129153-28-2	C ₁₂ H ₂₄ Cl ₂ Pt	4.2%	–
(MeCp)PtMe ₃ (UV curing)	94442-22-5	C ₉ H ₁₆ Pt	61.1%	319.30

Hydrosilylation catalysts are available in many concentrations and dilutions – please inquire.



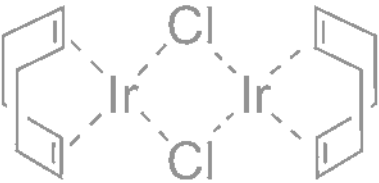
Ir(I) Compounds

Product Name	CAS No.	Formula	Avg. PM Content	Mol. Weight
[Ir(COD)Cl] ₂	12112-67-3	C ₁₆ H ₂₄ Cl ₂ Ir ₂	57.2%	671.70
[Ir(COD) ₂]BF ₄	35138-23-9	C ₁₆ H ₂₄ I ₂ Ir ₂	38.3%	495.39
[Ir(COD)OMe] ₂	12148-71-9	C ₁₆ H ₂₄ I ₂ Ir ₂	45.0%	854.60

Ir(III) Compounds

Product Name	CAS No.	Formula	Avg. PM Content	Mol. Weight
Ir acetate	52705-52-9	C ₁₂ H ₂₄ O ₁₆ Ir ₃	49.0%	1000.97
Ir(acac) ₃	15635-87-7	C ₁₅ H ₂₁ O ₆ Ir	39.3%	489.53
[IrCp*Cl ₂] ₂	12354-84-6	C ₂₀ H ₃₀ Cl ₄ Ir ₂	48.3%	796.71
R,R - Ir(Cp*)(TsDPEN)Cl	1244963-99-2	C ₃₁ H ₃₆ ClIrN ₂ O ₂ S	26.4%	728.38
S,S - Ir(Cp*)(TsDPEN)Cl	1099830-90-6	C ₃₁ H ₃₆ ClIrN ₂ O ₂ S	26.4%	728.38

Further iridium compounds, substitution patterns and information are available on request. Our technical experts will be pleased to advise you on your inquiries.





Rh(I) Compounds

Product Name	CAS No.	Formula	Avg. PM Content	Mol. Weight
Rh(PPh ₃) ₃ Cl	14694-95-2	C ₅₄ H ₄₅ P ₃ ClRh	11.1%	925.22
Rh(PPh ₃) ₃ (CO)(H)	17185-29-4	C ₅₅ H ₄₅ P ₃ ORh	11.2%	918.78
Rh(acac)(CO) ₂	14874-82-9	C ₇ H ₇ O ₄ Rh	39.9%	258.03
Rh(acac)(COD)	12245-39-5	C ₁₃ H ₁₉ O ₂ Rh	33.2%	310.19
Rh(acac)(ethylene) ₂	12082-47-2	C ₉ H ₁₅ O ₂ Rh	40.0%	258.12
Rh(acac)(PPh ₃)(CO)	25470-96-6	C ₂₄ H ₂₃ O ₃ PRh	20.9%	493.32
[Rh(ethylene) ₂ Cl] ₂	12081-16-2	C ₈ H ₁₆ Cl ₂ Rh ₂	53.0%	388.93
[Rh(COD)Cl] ₂	12092-47-6	C ₈ H ₁₆ Cl ₂ Rh ₂	51.0%	493.08
[Rh(COD) ₂]BF ₄	35138-22-8 / 207124-65-0	C ₁₆ H ₂₄ BF ₄ Rh	25.3%	406.07
[Rh(COD) ₂]OTf	99326-34-8	C ₁₇ H ₂₄ F ₃ O ₃ SRh	22.0%	468.34
[Rh(COD)(dppb)]BF ₄	79255-71-3	C ₃₆ H ₄₀ BF ₄ P ₂ Rh	14.2%	724.36
[Rh(COD)((R,R)-Et-Du-Phos)]BF ₄	228121-39-9	C ₃₀ H ₄₈ BF ₄ P ₂ Rh	15.6%	660.37
[Rh(nbd)Cl] ₂	12257-42-0	C ₁₄ H ₁₆ Cl ₂ Rh ₂	44.6%	460.99
[Rh(nbd) ₂]BF ₄	36620-11-8	C ₁₄ H ₁₆ BF ₄ Rh	27.5%	373.99
[Rh(nbd) ₂]OTf	178397-71-2	C ₁₅ H ₁₆ F ₃ O ₃ SRh	23.6%	436.25
Rh(acac)(nbd)	32354-50-0	C ₁₂ H ₁₅ O ₂ Rh	35.0%	294.16
[Rh(nbd)Cl] ₂	12257-42-0	C ₁₄ H ₁₆ Cl ₂ Rh	44.6%	461.00
[Rh(nbd) ₂]BF ₄	36620-11-8	C ₁₄ H ₁₆ BF ₄ Rh	27.5%	373.99

Further rhodium compounds, substitution patterns and information are available on request. Our technical experts will be pleased to advise you on your inquiries.



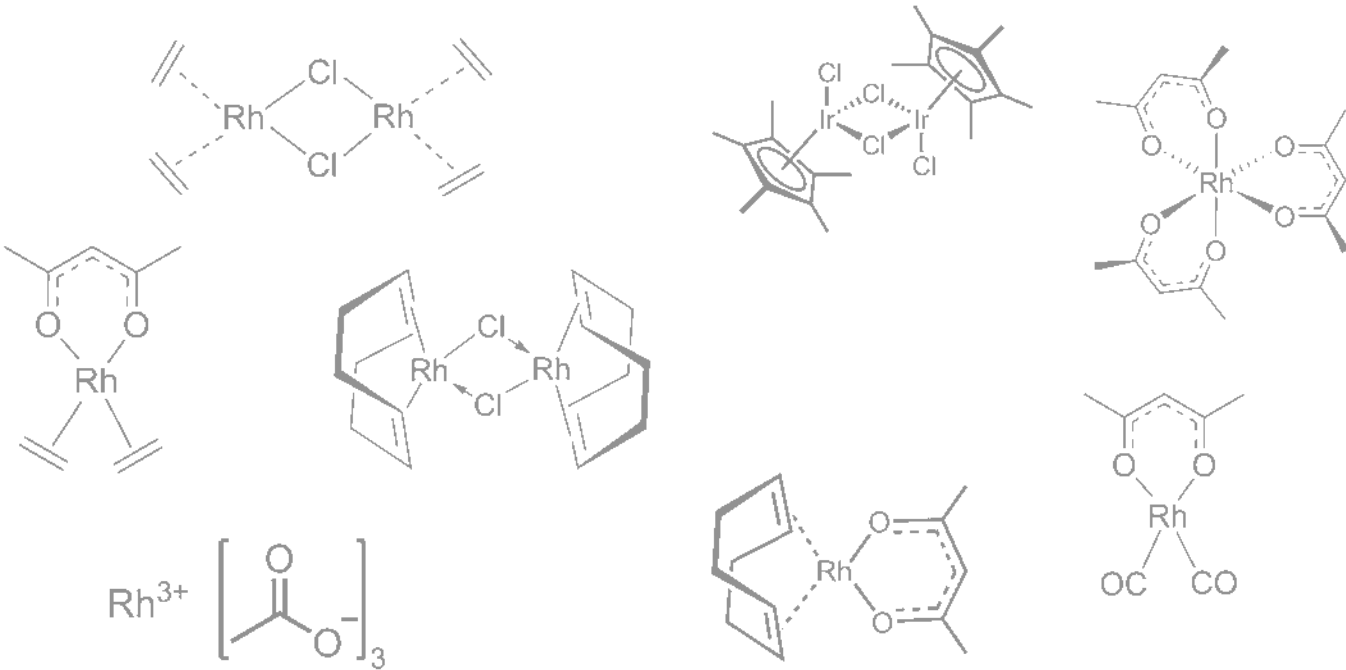
Rh(II) Compounds

Product Name	CAS No.	Formula	Avg. PM Content	Mol. Weight
Rh(II) acetate	15956-28-2	C ₈ H ₁₂ O ₈ Rh ₂	46.6%	441.99
Rh(II) octanoate	73482-96-9	C ₃₂ H ₆₀ O ₈ Rh ₂	26.4%	778.64
Rh(II) 2-ethylhexanoate	20845-92-5	C ₂₄ H ₄₅ O ₆ Rh	2.3%	532.52

Rh(III) Compounds

Product Name	CAS No.	Formula	Avg. PM Content	Mol. Weight
Rh(III) acetate	42204-14-8	C ₆ H ₉ O ₆ Rh	37.5%	280.04
Rh(acac) ₃	14284-92-5	C ₁₅ H ₂₁ O ₆ Rh	25.7%	403.26
[RhCp*Cl ₂] ₂	12354-85-7	C ₂₀ H ₃₀ Cl ₄ Rh ₂	16.7%	618.07
Rh(Cp*)(S,S -TsDPEN)Cl	1244964-49-5	C ₃₁ H ₃₆ ClN ₂ O ₂ RhS	16.1%	639.06
Rh(Cp*)(R,R -TsDPEN)Cl	1244959-33-8	C ₃₁ H ₃₆ ClN ₂ O ₂ RhS	16.1%	639.06
Rh(Cp*)(S,S -MsDPEN)Cl	1097730-64-7	C ₂₅ H ₃₂ ClN ₂ O ₂ RhS	18.3%	562.96
Rh(Cp*)(R,R -MsDPEN)Cl	1097730-62-5	C ₂₅ H ₃₂ ClN ₂ O ₂ RhS	18.3%	562.96

Further rhodium compounds, substitution patterns and information are available on request. Our technical experts will be pleased to advise you on your inquiries.





Ru(0) Compounds

Product Name	CAS No.	Formula	Avg. PM Content	Mol. Weight
Ru₃(CO)₁₂	15243-33-1	C ₁₂ O ₁₂ Ru ₃	47.5%	639.33

Ru(I) Compounds

Product Name	CAS No.	Formula	Avg. PM Content	Mol. Weight
[CpRu(CO)₂]₂	12132-87-5	C ₁₄ H ₁₀ O ₄ Ru ₂	45.5%	444.37

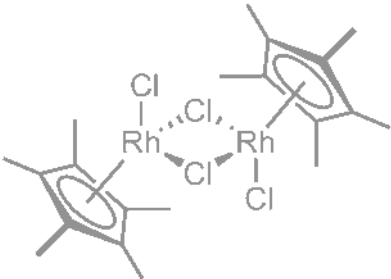
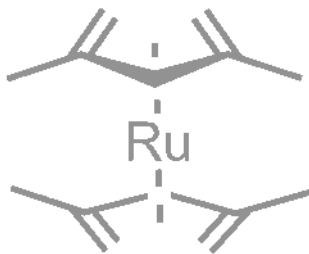
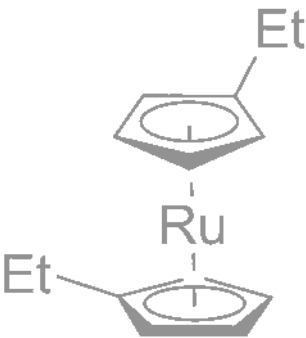
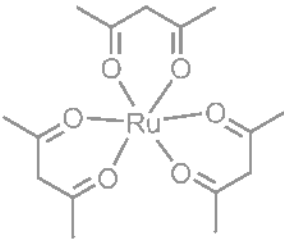
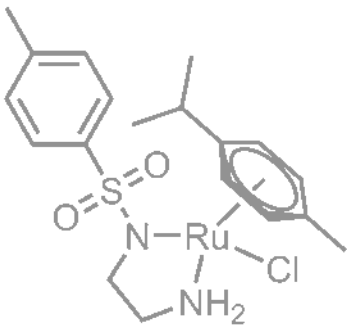
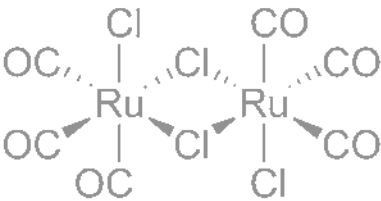
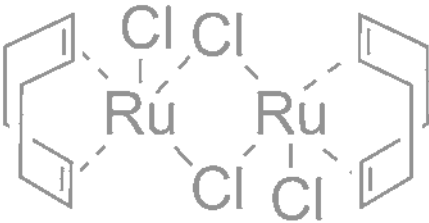
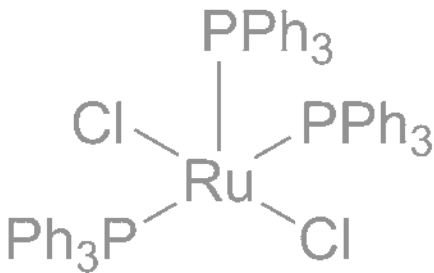
Ru(II) Compounds

Product Name	CAS No.	Formula	Avg. PM Content	Mol. Weight
Ru(PPh₃)₃Cl₂	15529-49-4	C ₅₄ H ₄₅ Cl ₂ P ₃ Ru	10.5%	958.83
[Ru(CO)₃Cl₂]₂	22594-69-0	C ₆ O ₆ Cl ₄ Ru ₂	39.5%	512.01
Ru(DMSO)₄Cl₂	11070-19-2	C ₈ H ₂₄ Cl ₂ O ₄ RuS ₄	20.8%	484.48
[Ru(COD)Cl₂]_n	50982-12-2	C ₈ H ₁₂ Cl ₂ Ru	33.5%	280.16
[Ru(benzene)Cl₂]₂	37366-09-9	C ₁₂ H ₁₂ Cl ₄ Ru ₂	40.4%	500.18
[Ru(toluene)Cl₂]₂	52462-27-8	C ₁₄ H ₁₆ Cl ₄ Ru ₂	38.3%	528.23
[Ru(p-cymene)Cl₂]₂	52462-29-0	C ₂₀ H ₂₈ Cl ₄ Ru ₂	33.0%	612.39
Ru(p-cymene)(TsEN)Cl	208988-63-0	C ₁₉ H ₂₇ ClN ₂ O ₂ RuS	20.9%	484.03
[Ru(mesitylene)Cl₂]₂	52462-31-4	C ₁₈ H ₂₄ Cl ₄ Ru ₂	34.6%	584.34
Ru(p-cymene)(S,S -TsDPEN)Cl	192139-90-5	C ₃₁ H ₃₅ ClN ₂ O ₂ RuS	15.9%	636.21
Ru(p-cymene)(R,R -TsDPEN)Cl	192139-92-7	C ₃₁ H ₃₅ ClN ₂ O ₂ RuS	15.9%	636.21
Ru(p-cymene)(S,S -MsDPEN)Cl	329371-25-7	C ₂₅ H ₃₁ ClN ₂ O ₂ RuS	18.0%	560.11
Ru(p-cymene)(R,R -MsDPEN)Cl	1097730-63-6	C ₂₅ H ₃₁ ClN ₂ O ₂ RuS	18.0%	560.11

Ru(III) Compounds

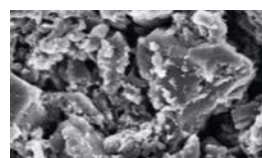
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Ru acetate	55466-76-7	C ₁₂ H ₁₈ O ₁₃ Ru ₃ .C ₂ H ₃ O ₂	34.7%	–
Ru(acac)₃	14284-93-6	C ₁₅ H ₂₁ O ₆ Ru	25.4%	398.39

Further ruthenium compounds and information are available on request. Our technical experts will be pleased to advise you on your inquiries.

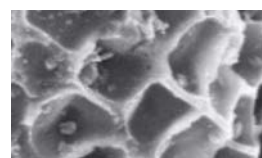


Activated carbon as Catalyst Support

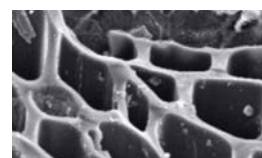
RAW MATERIAL



Coconut shell



Peat



Wood

CARBON SHAPE



Powder



Strands



Granules



Pellets

CHARACTERISTICS

- High specific surface area (BET): 700 – 1500 m²/g
- Bulk density: 250 – 500 g/L
- Diverse pore structures
- Huge adsorption capacity
- Chemically stable under acidic conditions
- Good filterability

PRE-TREATMENT

- Chemical: Phosphoric acid activated
- Physical: Steam activated

POST-TREATMENT

- Acid washed
- Non-acid washed



SAMPLE KIT – FINDING THE RIGHT CATALYST

Heraeus has developed an extensive portfolio of proprietary catalysts, designed for a variety of challenging catalytic reactions. To help identify the best catalyst for your specific process, Heraeus offers catalyst sample kits.

There may already be a catalyst that suits your process, or it could serve as the foundation for an improved, tailor-made catalyst adapted to your requirements.



Contact us to request your sample kit.

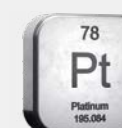
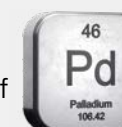
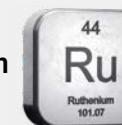
Applications of PM/C Catalysts

Each chemical reaction has its own unique chemical and physical constraints. The experts at Heraeus are dedicated to helping you identify, optimize, and develop catalysts tailored to your specific conditions.

PM/C materials can catalyze a wide range of hydrogenation reactions. The most important reactions, along with the appropriate catalysts, are shown in the following table:

			Pt/C	Pd/C	Ru/C
NITRO AND NITROSO COMPOUNDS					
Aromatic nitro compounds to anilines	<chem>c1ccc(cc1)[N+](=O)[O-]</chem> $\xrightarrow{H_2}$ <chem>Nc1ccccc1</chem>		✓	✓	
Halonitroaromatics to halogenated anilines	<chem>Clc1ccc(cc1)[N+](=O)[O-]</chem> $\xrightarrow{H_2}$ <chem>Nc1ccc(Cl)cc1</chem>		✓		
Nitroso compounds to anilines	<chem>c1ccc(cc1)[N+](=O)[O-]</chem> $\xrightarrow{H_2}$ <chem>Nc1ccccc1</chem>		✓	✓	
Nitro compounds to hydroxylamines	<chem>R[N+](=O)[O-]</chem> $\xrightarrow{H_2}$ <chem>RN(O)</chem>		✓		
CARBONYL COMPOUNDS					
Ketones/aldehydes to alkanes	<chem>RC(=O)R'</chem> $\xrightarrow{H_2}$ <chem>RR'</chem>		✓	✓	
Ketones/aldehydes to alcohols	<chem>RC(=O)R'</chem> $\xrightarrow{H_2}$ <chem>RC(O)R'</chem>		✓		✓
AROMATICS					
Ring hydrogenation	<chem>c1ccccc1</chem> $\xrightarrow{H_2}$ <chem>C1CCCCC1</chem>		✓	✓	✓
Aromatic ketones to alicyclic alcohols	<chem>c1ccc(cc1)C(=O)R</chem> $\xrightarrow{H_2}$ <chem>C1CCCCC1C(O)R</chem>			✓	✓
Anilines to cyclohexanones	<chem>Nc1ccccc1</chem> $\xrightarrow{H_2}$ <chem>O=C1CCCCC1</chem>			✓	
Dehydrogenation	<chem>C1CCCCC1</chem> $\xrightarrow{-H_2}$ <chem>c1ccccc1</chem>			✓	
C-C MULTIPLE BONDS					
Alkenes to alkanes	<chem>RC=CR'</chem> $\xrightarrow{H_2}$ <chem>RR'</chem>		✓	✓	
Alkynes to alkanes	<chem>RC#CR'</chem> $\xrightarrow{H_2}$ <chem>RR'</chem>			✓	
α,β-unsaturated carbonyl compounds	<chem>RC(=O)C=CR'</chem> $\xrightarrow{H_2}$ <chem>RC(=O)CCR'</chem>			✓	
NITRILES					
Nitriles to prim./sec./tert. amines	<chem>RCN</chem> $\xrightarrow{H_2}$ <chem>RCN(H)H</chem>		✓	✓	
Aromatic nitriles to aldehydes	<chem>c1ccc(cc1)C#N</chem> $\xrightarrow{H_2}$ <chem>O=Cc1ccccc1</chem>		✓	✓	
IMINES AND OXIMES					
Imines to amines	<chem>RC(=NR')R''</chem> $\xrightarrow{H_2}$ <chem>RC(NR')R''</chem>		✓	✓	
Oximes to amines	<chem>RC(=NOH)R'</chem> $\xrightarrow{H_2}$ <chem>RC(NH_2)R'</chem>		✓	✓	
OXIDATION AND DEHALOGENATION					
Alcohols to aldehydes and ketones	<chem>RC(OH)R'</chem> $\xrightarrow{O_2}$ <chem>RC(=O)R'</chem>		✓	✓	
Dehalogenation X = Cl, Br, I	<chem>RX</chem> $\xrightarrow{H_2}$ <chem>RH + HX</chem>			✓	

Additionally, Heraeus offers the customization and fine-tuning of a catalyst to find the most suitable fit for your application.



Catalysts on other support materials (alumina, titania, silica, etc.) and shapes (pellets, granules, etc.) are available. Contact us and we guide you to the most efficient option for your process including type, precious metal loading and recommended operating conditions.

Contact us – we guide you



Around the Globe ... and Around the Clock

About Heraeus Precious Metals

Heraeus Precious Metals is one of the world's leading players in the precious metals industry.

As part of the Heraeus Group, the company covers the value chain from trading to precious metals products to refining and recycling. It has extensive expertise in all platinum group metals as well as gold and silver.

With about 2,500 employees at 11 sites worldwide, Heraeus Precious Metals offers a broad portfolio of products that are essential for many industries such as the automotive, chemicals, semiconductor, aerospace, pharmaceutical and hydrogen industry.

Precious Metal Catalysts – Footprint

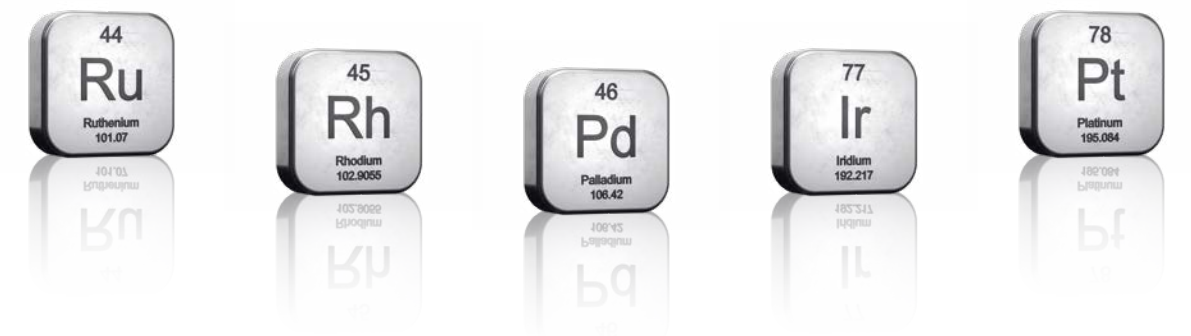


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Circular – Products Made with 100% Recycled Platinum Group Metals

Using recycled platinum group metals (PGMs) can support your Scope 3 greenhouse gas reduction strategy: Depending on the metal, the industry average emission factor of secondary PGMs are 98.2% to 98.8% lower than those of primary PGMs.¹ Meanwhile, precious metals that are recovered using recycling processes have the same high quality and purity as primary metals.

All Circlear precious metals are 100% recycled, originating from secondary sources such as spent chemical or automotive catalysts. This is based on mass balance approach², which is verified by TÜV Süd in accordance with ISO 14021.

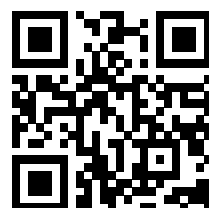


¹ Comparisons are based on data from International Platinum Group Metals Association, "The Life Cycle Assessment of Platinum Group Metals", 2025 (reference year 2022).

² Circlear uses mass-balance allocation. The physical precious metal in an individual delivery is not necessarily traceable exclusively to secondary feedstock. For every quantity sold as Circlear, an equivalent quantity of precious metal from secondary sources has been acquired by Heraeus.

Heraeus Precious Metals

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